Embryonic mercury exposure in zebrafish: Alteration of metabolites and gene expression, related to visual and behavioral impairments

ABSTRACT

The widespread presence of mercury, a heavy metal found in the environment and used in numerous industries and domestic, raises concerns about its potential impact on human health. Nevertheless, the adverse effects of this environmental toxicant at low concentrations are often underestimated. There are emerging studies showing that accumulation of mercury in the eye may contribute to visual impairment and a comorbidity between autism spectrum disorders (ASD) trait and visual impairment. However, the underlying mechanism of visual impairment in humans and rodents is challenging. In response to this issue, zebrafish larvae with a cone–dominated retinal visual system were exposed to 100 nM mercury chloride ($HgCl_2$), according to our previous study, followed by light–dark stimulation, a social assay, and color preference to examine the functionality of the visual system in relation to ASD–like behavior. Exposure of embryos to $HgCl_2$ from gastrulation to hatching increased locomotor activity in the dark, reduced shoaling and exploratory behavior, and impaired color preference. Defects in microridges as the first barrier may serve as primary tools for $HgCl_2$ toxicity affecting vision. Depletion of polyunsaturated fatty acids (PUFAs), linoleic acid, arachidonic acid (ARA), alpha–linoleic acid, docosahexaenoic acid (DHA), stearic acid, L–phenylalanine, isoleucine, L–lysine, and N–acetylputrescine, along with the increase of gamma–aminobutyric acid (GABA), sphingosine–1–phosphate, and citrulline assayed by liquid chromatography–mass spectrometry (LC–MS) suggest that these metabolites serve as biomarkers of retinal impairments that affect vision and behavior. Although suppression of adsl, shank3a, tsc1b, and nrxn1a gene expression was observed, among these tsc1b showed more positive correlation with ASD. Collectively, these results contribute new insights into the possible mechanism of mercury toxicity give rise to visual, cognitive, and social deficits in zebrafish.